# Polymer Electrolytic (KO-CAP®), 6.3 – 35 VDC

KEMET a YAGEO company

## Overview

KO-CAP Polymer Capacitors

The KEMET Organic Capacitors (KO-CAP) are preferred solutions for applications requiring power loss protection (hold-up) or maximum power efficiency of a circuit when board space is limited. Desired benefits include high energy density, stable capacitance with applied voltage and temperature, and no aging effects. The conductive polymer cathode of these solid electrolytic capacitors provide very low ESR and higher capacitance retention at high frequencies. Unlike liquid electrolyte-based capacitors, KEMET polymer capacitors have a very long operational life and high ripple current capabilities. Capacitors from T520, T521, and T523 series are commonly used in these applications. The T545 and T548 were introduced to meet specific needs for a subsegment of solid state drives.

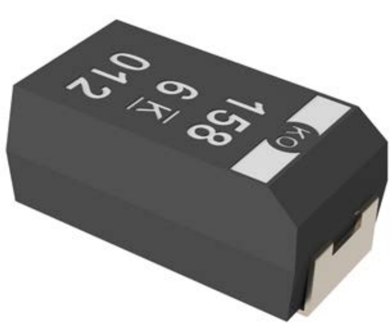
## Benefits

- Highest energy per unit volume
- Stable capacitance across temperature and voltage
- No aging effects
- Low ESR values
- High frequency capacitance retention
- High ripple handling
- 100% accelerated steady state aging
- 100% surge current tested
- Halogen-free epoxy and RoHS compliant

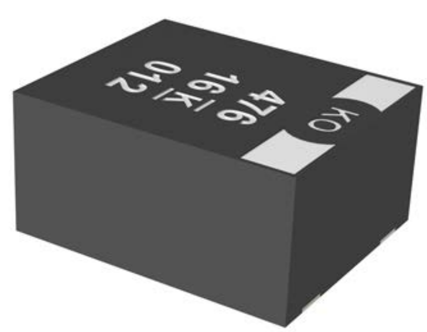
## Applications

Typical applications include enterprise storage, networking, server, mobile, client storage, and client computing.

T520 / T521 / T545



T523 / T548



## Environmental Compliance

- RoHS compliant when ordered with 100% Sn solder or Ni-Pd-Au
- Halogen-free
- Epoxy compliant with UL94 V–0

## K-SIM

For a detailed analysis of specific part numbers, please visit ksim.kemet.com to access KEMET's K-SIM software. KEMET K-SIM is designed to simulate behavior of components with respect to frequency, ambient temperature, and DC bias levels.

## Ordering Information

| T | 548 | V | 157 | M | 016 | A | T | E050 | |
|---|---|---|---|---|---|---|---|---|---|
| Capacitor Class | Series | Case Size | Capacitance Code (pF) | Capacitance Tolerance | Rated Voltage (VDC) | Failure Rate/ Design | Termination Finish | ESR | Packaging (C-Spec) |
| T = Tantalum | 520 = Low voltage<br>521 = High voltage<br>523 = Facedown terminal<br>545 = High energy<br>548 = High energy, facedown terminal | B, G, H, J, M, O, T, V, W, X, Y | First two digits represent significant figures. Third digit specifies number of zeros. | K = ±10%<br>M = ±20% | 006 = 6.3<br>010 = 10<br>016 = 16<br>020 = 20<br>025 = 25<br>035 = 35 | A = N/A | T = 100% matte tin (Sn)-plated<br>P* = Ni-Pd-Au-plated | ESR in mΩ | Blank = 7" reel<br>7280 = 13" reel |

** P termination only available on T523/T548 part numbers*

## Performance Characteristics

| Item | Performance Characteristics |
|---|---|
| Operating Temperature | −55°C to 85°C/125°C (refer to part number in Table 1 for maximum temperature rating) |
| Rated Capacitance Range | 22 – 1,500 µF at 120 Hz/25°C |
| Capacitance Tolerance | K tolerance (10%), M tolerance (20%) |
| Rated Voltage Range | 6.3 – 35 VDC |
| DF (120 Hz) | Refer to part number in Table 1 for electrical specification |
| ESR (100 kHz) | Refer to part number in Table 1 for electrical specification |
| Leakage Current | ≤ 0.1 CV (µA) at rated voltage after 5 minutes (refer to part number in Table 1 for electrical specification) |

## Qualification

| Test | Condition | Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Endurance | 85°C or 105°C at rated voltage, 2,000 hours**<br>125°C at 2/3 rated voltage, 2,000 hours ** | Δ C/C | Within −20/+10% of initial value | | | | | |
| | | DF | Within initial limit<br>Within 2.0 x initial limit *1 | | | | | |
| | | DCL | Within 1.25 x initial limit<br>Within 2.0 x initial limit *1 | | | | | |
| | | ESR | Within 2.0 x initial limit | | | | | |
| Storage Life | 85°C/105°C/125°C at 0 volts, 2,000 hours** | Δ C/C | Within −20%/+10% of initial value | | | | | |
| | | DF | Within initial limit<br>Within 2.0 x initial limit *1 | | | | | |
| | | DCL | Within 1.25 x initial limit<br>Within 2.0 x initial limit *1 | | | | | |
| | | ESR | Within 2.0 x initial limit | | | | | |
| Humidity | 60°C, 90% RH, no load, 500 hours | Δ C/C | Within −5% /+35% | | | | | |
| | | DF | Within initial limit | | | | | |
| | | DCL | Within 5.0 x initial limit | | | | | |
| | | ESR | Within 2.0 x initial limit | | | | | |
| Temperature Stability | Extreme temperature exposure at a succession of continuous steps at +25°C, −55°C, +25°C, +85°C, +105°C**, +25°C | | +25°C | −55°C | +25°C | +85°C | +105°C** | +25°C |
| | | Δ C/C | IL* | ±20% | ±10% | ±20% | ±30% | ±10% |
| | | DF | IL | IL | IL | 1.2 x IL | 1.5 x IL | IL |
| | | DCL | IL | N/A | IL | 10 x IL | 10 x IL | IL |
| Surge Voltage | 85°C/105°C/125°C, 1.32 x rated voltage*2, 1,000 cycles ** | Δ C/C | Within −20/+10% of initial value | | | | | |
| | | DF | Within initial limits | | | | | |
| | | DCL | Within initial limits | | | | | |
| | | ESR | Within initial limits | | | | | |
| Mechanical Shock/ Vibration | MIL−STD−202, Method 213 and 204<br>Condition I, 100 G peak<br>Condition D, 20 G for 20 minutes/12 cycles each of 3 orientations. Test from 10 ~ 2,000 Hz | Δ C/C | Within ±10% of initial value<br>(Within initial limits for T527 Series) | | | | | |
| | | DF | Within initial limits | | | | | |
| | | DCL | Within initial limits | | | | | |

** IL = Initial limit*
*** Refer to Table 1 - Ratings & Part Number Reference for temperature classification. If temperature classification is 85°C, the 105°C step is not performed for the temperature stability test.*
**1 For 125°C rated part numbers*
**2 For PN T523W476M035AP/T523V686M035AP test voltage is 1.15 x $V_R$*

## Reliability

KO-CAP capacitors have an average failure rate of 0.5 %/1,000 hours at category voltage, $U_C$, and category temperature, $T_C$. These capacitors are qualified using industry test standards at $U_C$ and $T_C$. The minimum test time (1,000 hours or 2,000 hours) is dependent on the product.

The actual life expectancy of KO-CAP capacitors increases when application voltage, $U_A$, and application temperature, $T_A$, are lower than $U_C$ and $T_C$. As a general guideline, when $U_A < 0.9 * U_C$ and $T_A <$ 85°C, the life expectancy will typically exceed the useful lifetime of most hardware (> 10 years).

The lifetime of a KO-CAP capacitor at a specific application voltage and temperature can be modeled using the equations below. A failure is defined as passing enough current to blow a 1-amp fuse. The calculation is an estimation based on empirical results and is not a guarantee.

$$VAF = \left(\frac{U_C}{U_A}\right)^n$$

where:

VAF = acceleration factor due to voltage, unitless

$U_C$ = category voltage, volt

$U_A$ = application voltage, volt

n = exponent, 16

$$TAF = e^{\left[\frac{E_a}{k}\left(\frac{1}{273+T_A} - \frac{1}{273+T_C}\right)\right]}$$

where:

TAF = acceleration factor due to temperature, unitless

$E_a$ = activation energy, 1.4 eV

k = Boltzmann's constant, 8.617E-5 eV/K

$T_A$ = application temperature, °C

$T_C$ = category temperature, °C

$$AF = VAF * TAF$$

where:

AF = acceleration factor, unitless

TAF = accerlation factor due to temperature, unitless

VAF = acceleration factor due to voltage, unitless

$$Life_{U_A,T_A} = Life_{U_C,T_C} * AF$$

where:

$Life_{UA,\,TA}$ = estimated life application voltage and temperature, years

$Life_{UC,\,TC}$ = guaranteed life category voltage and temperature, years

AF = acceleration factor, unitless

*Terms:*
*Category voltage, $U_C$ : maximum recommended peak DC operating voltage for continuous operation at the category temperature, $T_C$*
*Rated voltage, $U_R$ : maximum recommended peak DC operating voltage for continuous operation up to the rated temperature, $T_R$*
*Category temperature, $T_C$ : maximum recommended operating temperature. Voltage derating may be required at $T_C$*
*Rated temperature, $T_R$ : maximum recommended operating temperature without voltage derating. $T_R$ is equal to or lower than $T_C$*

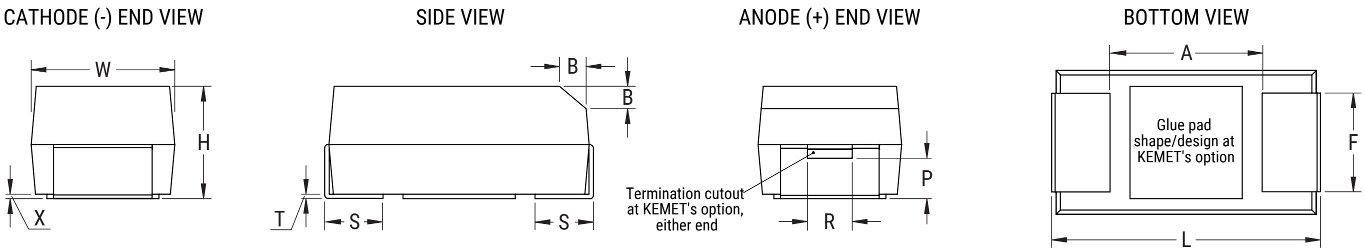
**Reliability Table 1 – Common temperature range classifications**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 85°C ($T_R$) / 85°C ($T_C$) | Rated Voltage ($U_R$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| | Category Voltage ($U_C$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| 105°C ($T_R$) / 105°C ($T_C$) | Rated Voltage ($U_R$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| | Category Voltage ($U_C$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| 105°C ($T_R$) / 125°C ($T_C$) | Rated Voltage ($U_R$) | 2.5 | 4.0 | 6.3 | 8.0 | 10.0 | 12.5 | 16.0 | 20.0 | 25.0 | 35.0 | 50.0 | 63.0 | 75.0 |
| | Category Voltage ($U_C$) | 1.7 | 2.7 | 4.2 | 5.4 | 6.7 | 8.4 | 10.7 | 13.4 | 16.8 | 23.5 | 33.5 | 42.2 | 50.3 |

## Dimensions – Millimeters (Inches)

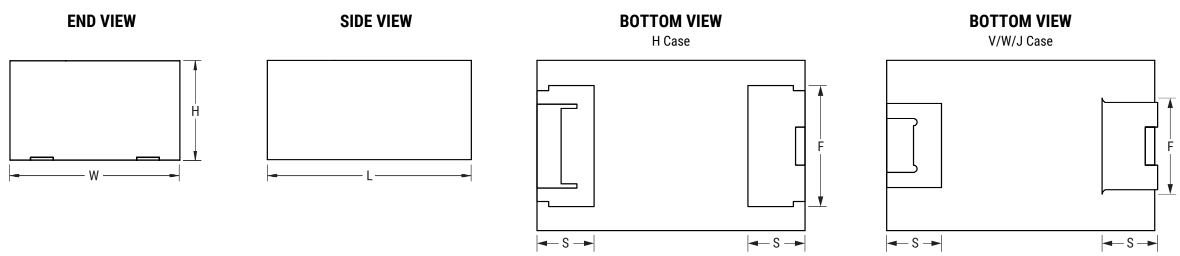
Metric will govern

### For T520 / T521 / T545




| KEMET | EIA | L | W | H | F ±0.1 (±0.004) | S ±0.3 (±0.012) | B ±0.15 (Ref) ±0.006 | X (Ref) | P (Ref) | R (Ref) | T (Ref) | A (Min) | Typical Weight (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T | 3528-12 | 3.5 ±0.2 (0.138 ±0.008) | 2.8 ±0.2 (0.110 ±0.008) | 1.1 ±0.1 (0.043 ±0.004) | 2.2 (0.087) | 0.80 (0.032) | N/A | 0.05 (0.002) | N/A | N/A | 0.13 (0.005) | 1.9 (0.075) | 55 |
| M | 3528-15 | 3.5 ±0.2 (0.138 ±0.008) | 2.8 ±0.2 (0.110 ±0.008) | 1.4 ±0.1 (0.055 ±0.004) | 2.2 (0.087) | 0.8 (0.031) | N/A | 0.05 (0.002) | N/A | N/A | 0.13 (0.005) | 1.1 (0.043) | 98 |
| B | 3528-21 | 3.5 ±0.2 (0.138 ±0.008) | 2.8 ±0.2 (0.110 ±0.008) | 1.9 ±0.2 (0.075 ±0.008) | 2.2 (0.087) | 0.80 (0.032) | 0.4 (0.016) | 0.10 ±0.10 (0.004 ±0.004) | 0.5 (0.020) | 1.0 (0.039) | 0.13 (0.005) | 1.9 (0.075) | 95 |
| W | 7343-15 | 7.3 ±0.3 (0.287 ±0.012) | 4.3 ±0.3 (0.169 ±0.012) | 1.4 ±0.1 (0.055 ±0.004) | 2.4 (0.094) | 1.30 (0.051) | N/A | 0.05 (0.002) | N/A | N/A | 0.13 (0.005) | 3.6 (0.142) | 223 |
| V | 7343-20 | 7.3 ±0.3 (0.287 ±0.012) | 4.3 ±0.3 (0.169 ±0.012) | 1.9 ±0.1 (0.075 ±0.004) | 2.4 (0.094) | 1.30 (0.051) | N/A | 0.05 (0.002) | N/A | N/A | 0.13 (0.005) | 3.6 (0.142) | 274 |
| Y | 7343-40 | 7.3 ±0.3 (0.287 ±0.012) | 4.3 ±0.3 (0.169 ±0.012) | 3.8 ±0.2 (0.150 ±0.008) | 2.4 (0.094) | 1.3 (0.051) | 0.5 (0.020) | 0.10 ±0.10 (0.004 ±0.004) | 1.7 (0.067) | 1.0 (0.039) | 0.13 (0.005) | 3.8 (0.150) | 494 |
| X | 7343-43 | 7.3 ±0.3 (0.287 ±0.012) | 4.3 ±0.3 (0.169 ±0.012) | 4.0 ±0.3 (0.157 ±0.012) | 2.4 (0.094) | 1.30 (0.051) | 0.5 (0.020) | 0.10 ±0.10 (0.004 ±0.004) | 1.7 (0.067) | 1.0 (0.039) | 0.13 (0.005) | 3.6 0.142) | 554 |
| J | 7360-15 | 7.3 ±0.3 (0.287 ±0.012) | 6.0 ±0.3 (0.236 ±0.012) | 1.4 ±0.1 (0.055 ±0.004) | 4.1 (0.161) | 1.30 (0.051) | N/A | 0.10 ±0.10 (0.004 ±0.004) | N/A | N/A | 0.13 (0.005) | 3.8 (0.150) | 263 |
| H | 7360-20 | 7.3 ±0.3 (0.287 ±0.012) | 6.0 ±0.3 (0.236 ±0.012) | 1.9 ±0.1 (0.075 ±0.004) | 4.1 (0.161) | 1.3 (0.051) | N/A | 0.10 ±0.10 (0.004 ±0.004) | N/A | N/A | 0.13 (0.005) | 3.8 (0.150) | 385 |
| O | 7360-43 | 7.3 ±0.3 (0.287 ±0.012) | 6.0 ±0.3 (0.236 ±0.012) | 4.0 ±0.3 (0.157 ±0.012) | 4.1 (0.161) | 1.3 (0.051) | N/A | 0.10 ±0.10 (0.004 ±0.004) | N/A | N/A | 0.13 (0.005) | 3.8 (0.150) | 696 |

### For T523 / T548




| KEMET | EIA | L | W | H | F ±0.1 (±0.004) | S ±0.3 (±0.012) | Typical Weight (mg) |
|---|---|---|---|---|---|---|---|
| W | 7343-15 | 7.3 ±0.3 (0.287 ±0.012) | 4.3 ±0.3 (0.169 ±0.012) | 1.4 ±0.1 (0.055 ±0.004) | 2.4 (0.094) | 1.3 (0.051) | 223 |
| G | 7360-12 | 7.3 ±0.3 (0.287 ±0.012) | 6.0 ±0.3 (0.236 ±0.012) | 1.2 ±0.1 (0.047 ±0.004) | 4.45 (0.175) | 1.6 (0.063) | – |
| J | 7360-15 | 7.3 ±0.3 (0.287 ±0.012) | 6.0 ±0.3 (0.236 ±0.012) | 1.5 ±0.1 (0.059 ±0.004) | 4.45 (0.175) | 1.6 (0.063) | 263 |
| V | 7343-20 | 7.3 ±0.3 (0.287 ±0.012) | 4.3 ±0.3 (0.169 ±0.012) | 1.9 ±0.1 (0.075 ±0.004) | 2.4 (0.094) | 1.3 (0.051) | 274 |
| H | 7360-20 | 7.3 ±0.3 (0.287 ±0.012) | 6.0 ±0.3 (0.236 ±0.012) | 1.9 ±0.1 (0.075 ±0.004) | 4.45 (0.175) | 1.6 (0.063) | 385 |

## Table 1 – Ratings & Part Number Reference

| Rated Voltage | Rated Capacitance | Case Code/ Case Size | KEMET Part Number | Energy | Maximum DC Leakage at 25°C, $V_R$, 5 min charge time | Maximum DF at 25°C, 120 Hz | Maximum ESR at 25°C, 100 kHz | Maximum Allowable RMS Ripple Current at 45°C, 100 kHz | MSL | Maximum Operating Temperature |
|---|---|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/ EIA | | mJ | µA | % | mΩ | mA | | °C |
| 6.3 | 100 | T/3528-12 | T520T107M006APE070 | 1.2 | 63.0 | 10 | 70 | 1,230 | 3 | 105 |
| 6.3 | 150 | T/3528-12 | T520T157M006ATE070 | 1.7 | 94.5 | 10 | 70 | 1,230 | 3 | 105 |
| 6.3 | 150 | M/3528-15 | T520M157M006ATE070 | 1.7 | 94.5 | 10 | 70 | 1,310 | 3 | 105 |
| 6.3 | 220 | B/3528-21 | T520B227M006ATE070 | 2.5 | 138.6 | 10 | 70 | 1,350 | 3 | 105 |
| 6.3 | 330 | V/7343-20 | T545V337M006ATE045 | 3.8 | 207.9 | 10 | 45 | 2,040 | 3 | 105 |
| 6.3 | 470 | W/7343-15 | T545W477M006ATE035 | 5.4 | 296.1 | 10 | 35 | 2,270 | 3 | 105 |
| 6.3 | 470 | W/7343-15 | T545W477M006ATE045 | 5.4 | 296.1 | 10 | 45 | 2,000 | 3 | 105 |
| 6.3 | 470 | W/7343-15 | T545W477M006ATE055 | 5.4 | 296.1 | 10 | 55 | 1,810 | 3 | 105 |
| 6.3 | 470 | V/7343-20 | T545V477M006ATE055 | 5.4 | 296.1 | 10 | 55 | 1,850 | 3 | 105 |
| 6.3 | 680 | X/7343-43 | T520X687M006ATE025 | 7.9 | 428.4 | 10 | 25 | 3,150 | 3 | 105 |
| 6.3 | 680 | J/7360-15 | T523J687M006APE070 | 7.9 | 428.0 | 10 | 70 | 2,510 | 3 | 85 |
| 6.3 | 1,000 | H/7360-20 | T545H108M006ATE055 | 11.6 | 630.0 | 20 | 55 | 1,850 | 3 | 85 |
| 6.3 | 1,500 | H/7360-20 | T520H158M006ATE055 | 17.4 | 945.0 | 20 | 55 | 1,800 | 3 | 85 |
| 6.3 | 1,500 | H/7360-20 | T520H158M006ATE035 | 17.4 | 945.0 | 20 | 35 | 2,320 | 3 | 85 |
| 6.3 | 1,500 | H/7360-20 | T545H158M006ATE035 | 17.4 | 945.0 | 20 | 35 | 2,320 | 3 | 85 |
| 6.3 | 1,500 | H/7360-20 | T545H158M006ATE055 | 17.4 | 945.0 | 20 | 55 | 1,850 | 3 | 85 |
| 10 | 330 | Y/7343-40 | T545Y337M010ATE035 | 11.9 | 330.0 | 10 | 35 | 2,630 | 3 | 105 |
| 10 | 220 | V/7343-20 | T545V227M010ATE045 | 7.9 | 220.0 | 10 | 45 | 2,040 | 3 | 105 |
| 10 | 330 | G/7360-12 | T523G337M010APE150 | 11.0 | 330.0 | 10 | 150 | 1,410 | 4 | 85 |
| 10 | 330 | J/7360-15 | T523J337M010APE070 | 11.9 | 330.0 | 10 | 70 | 2,510 | 3 | 85 |
| 10 | 390 | G/7360-12 | T523G397M010APE150 | 14.0 | 390.0 | 10 | 150 | 1,410 | 4 | 85 |
| 10 | 470 | J/7360-15 | T523J477M010APE070 | 16.9 | 470.0 | 10 | 70 | 2,510 | 4 | 85 |
| 10 | 820 | H/7360-20 | T520H827M010ATE055 | 29.5 | 820.0 | 10 | 55 | 1,910 | 3 | 85 |
| 10 | 1,000 | H/7360-20 | T523H108M010APE070 | 36.0 | 1000.0 | 10 | 70 | 2,510 | 4 | 85 |
| 16 | 22 | B/3528-21 | T521B226M016ATE070 | 1.7 | 35.2 | 10 | 70 | 1,350 | 3 | 105 |
| 16 | 33 | T/3528-12 | T521T336M016ATE070 | 2.6 | 52.8 | 10 | 70 | 1,230 | 3 | 105 |
| 16 | 47 | T/3528-12 | T523T476M016APE090 | 3.6 | 75.2 | 10 | 90 | 1,080 | 4 | 85 |
| 16 | 47 | W/7343-15 | T545W476M016ATE045 | 3.6 | 75.2 | 10 | 45 | 2,000 | 3 | 105 |
| 16 | 47 | V/7343-20 | T545V476M016ATE045 | 3.6 | 75.2 | 10 | 45 | 2,040 | 3 | 105 |
| 16 | 47 | V/7343-20 | T545V476M016ATE070 | 3.6 | 75.2 | 10 | 70 | 1,640 | 3 | 105 |
| 16 | 68 | W/7343-15 | T523W686M016APE050 | 5.3 | 108.8 | 10 | 50 | 2,820 | 3 | 105 |
| 16 | 68 | W/7343-15 | T523W686M016APE070 | 5.3 | 108.8 | 10 | 70 | 2,376 | 3 | 105 |
| 16 | 68 | W/7343-15 | T523W686M016APE100 | 5.3 | 108.8 | 10 | 100 | 1,988 | 3 | 105 |
| 16 | 100 | W/7343-15 | T523W107M016APE050 | 7.7 | 160.0 | 10 | 50 | 2,820 | 3 | 105 |
| 16 | 100 | W/7343-15 | T523W107M016APE070 | 7.7 | 160.0 | 10 | 70 | 2,376 | 3 | 105 |
| 16 | 100 | W/7343-15 | T523W107M016APE100 | 7.7 | 160.0 | 10 | 100 | 1,988 | 3 | 105 |
| 16 | 100 | V/7343-20 | T545V107M016ATE050 | 7.7 | 160.0 | 10 | 50 | 1,940 | 3 | 105 |
| 16 | 150 | W/7343-15 | T523W157M016APE050 | 11.6 | 240.0 | 10 | 50 | 2,820 | 3 | 105 |
| 16 | 150 | W/7343-15 | T523W157M016APE070 | 11.6 | 240.0 | 10 | 70 | 2,376 | 3 | 105 |
| 16 | 150 | W/7343-15 | T523W157M016APE100 | 11.6 | 240.0 | 10 | 100 | 1,988 | 3 | 105 |
| 16 | 150 | V/7343-20 | T523V157M016APE050 | 11.6 | 240.0 | 10 | 50 | 2,870 | 3 | 105 |
| 16 | 150 | V/7343-20 | T523V157M016APE070 | 11.6 | 240.0 | 10 | 70 | 2,420 | 3 | 105 |
| 16 | 150 | V/7343-20 | T523V157M016APE100 | 11.6 | 240.0 | 10 | 100 | 2,030 | 3 | 105 |
| 16 | 150 | V/7343-20 | T521V157M016ATE040 | 11.6 | 240.0 | 10 | 40 | 2,160 | 3 | 105 |
| 16 | 150 | V/7343-20 | T521V157M016ATE050 | 11.6 | 240.0 | 10 | 50 | 1,930 | 3 | 105 |
| 16 | 150 | V/7343-20 | T521V157M016ATE070 | 11.6 | 240.0 | 10 | 70 | 1,630 | 3 | 105 |
| 16 | 150 | V/7343-20 | T521V157M016ATE100 | 11.6 | 240.0 | 10 | 100 | 1,370 | 3 | 105 |
| 16 | 150 | X/7343-43 | T545X157M016ATE040 | 11.6 | 240.0 | 10 | 40 | 2,490 | 3 | 105 |
| 16 | 150 | G/7360-12 | T523G157M016APE150 | 11.6 | 240.0 | 10 | 150 | 1,410 | 4 | 85 |
| 16 | 180 | H/7360-20 | T545H187M016ATE055 | 13.9 | 288.0 | 20 | 55 | 1,910 | 3 | 85 |
| 16 | 220 | X/7343-43 | T545X227M016ATE035 | 17.0 | 352.0 | 10 | 35 | 2,660 | 3 | 105 |
| 16 | 220 | J/7360-15 | T523J227M016APE070 | 17.0 | 352.0 | 10 | 70 | 2,510 | 3 | 85 |
| 16 | 220 | H/7360-20 | T523H227M016APE070 | 17.0 | 352.0 | 10 | 70 | 2,510 | 3 | 85 |
| 16 | 330 | X/7343-43 | T545X337(1)016ATE025 | 25.5 | 528.0 | 10 | 25 | 3,150 | 3 | 105 |
| VDC | µF | KEMET/ EIA | | mJ | µA | % | mΩ | mA | | °C |
| Rated Voltage | Rated Capacitance | Case Code/ Case Size | KEMET Part Number | Energy | Maximum DC Leakage | Maximum DF | Maximum ESR | Maximum Allowable RMS Ripple Current | MSL | Maximum Operating Temperature |

*Part numbers marked in orange font are not recommended for new designs. KEMET recommends the use of part numbers shown in the above table within same Cap/Volt/Case and ESR in black font text.*
*(1) To complete KEMET part number, insert M for ±20% or K for ±10%. Designates capacitance tolerance.*
*Refer to Ordering Information for additional detail.*
*Energy (mJ) = 0.5 * Nominal Cap * (Application Voltage^2 - Dropout Voltage^2) / 1,000; Cap = µF*
*Application Voltage = 90% of $V_R$ (≤ 10 V) / 80% of $V_R$ (> 10 V)*
*Dropout Voltage = 3 V was used for the calculation*

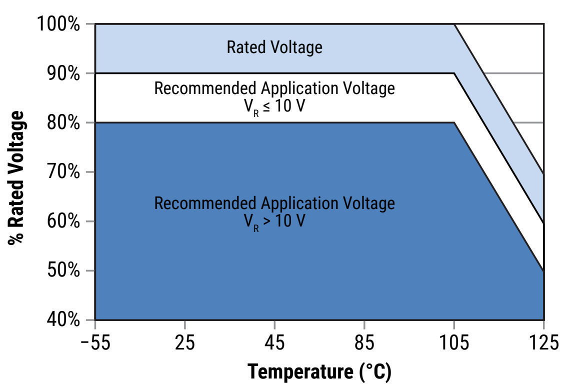
## Table 1 – Ratings & Part Number Reference cont.

| Rated Voltage | Rated Capacitance | Case Code/ Case Size | KEMET Part Number | Energy | Maximum DC Leakage at 25°C, $V_R$, 5 min charge time | Maximum DF at 25°C, 120 Hz | Maximum ESR at 25°C, 100 kHz | Maximum Allowable RMS Ripple Current at 45°C, 100 kHz | MSL | Maximum Operating Temperature |
|---|---|---|---|---|---|---|---|---|---|---|
| VDC | µF | KEMET/ EIA | | mJ | µA | % | mΩ | mA | | °C |
| 16 | 330 | H/7360-20 | T548H337M016APE070 | 25.5 | 528.0 | 10 | 70 | 2,510 | 4 | 85 |
| 16 | 330 | H/7360-20 | T523H337M016APE070 | 25.5 | 528.0 | 10 | 70 | 2,510 | 3 | 85 |
| 16 | 470 | H/7360-20 | T523H477M016APE070 | 36.4 | 752.0 | 10 | 70 | 2,510 | 4 | 85 |
| 20 | 22 | B/3528-21 | T521B226M020ATE070 | 2.7 | 44.0 | 10 | 70 | 1,350 | 3 | 105 |
| 20 | 47 | W/7343-15 | T545W476M020ATE045 | 5.8 | 94.0 | 10 | 45 | 2,000 | 3 | 105 |
| 20 | 47 | W/7343-15 | T545W476M020ATE055 | 5.8 | 94.0 | 10 | 55 | 1,810 | 3 | 105 |
| 20 | 47 | V/7343-20 | T545V476M020ATE070 | 5.8 | 94.0 | 10 | 70 | 1,640 | 3 | 105 |
| 20 | 68 | W/7343-15 | T523W686(1)020APE100 | 8.4 | 136.0 | 10 | 100 | 1,988 | 3 | 105 |
| 20 | 68 | V/7343-20 | T523V686M020APE100 | 8.4 | 136.0 | 10 | 100 | 2,030 | 4 | 105 |
| 20 | 100 | W/7343-15 | T523W107(1)020APE050 | 12.4 | 200.0 | 10 | 50 | 2,820 | 3 | 105 |
| 20 | 100 | W/7343-15 | T523W107(1)020APE070 | 12.4 | 200.0 | 10 | 70 | 2,376 | 3 | 105 |
| 20 | 100 | W/7343-15 | T523W107(1)020APE100 | 12.4 | 200.0 | 10 | 100 | 1,988 | 3 | 105 |
| 20 | 100 | V/7343-20 | T545V107M020ATE055 | 12.4 | 200.0 | 10 | 55 | 1,850 | 3 | 125 |
| 25 | 33 | W/7343-15 | T523W336M025APE100 | 6.5 | 82.5 | 10 | 100 | 1,988 | 4 | 105 |
| 25 | 47 | V/7343-20 | T523V476M025APE100 | 9.2 | 117.5 | 10 | 100 | 2,030 | 4 | 105 |
| 25 | 100 | V/7343-20 | T523V107M025APE070 | 19.6 | 250.0 | 10 | 70 | 2,420 | 4 | 105 |
| 25 | 100 | V/7343-20 | T523V107M025APE100 | 19.6 | 250.0 | 10 | 100 | 2,030 | 4 | 105 |
| 25 | 150 | H/7360-20 | T523H157M025APE070 | 29.3 | 375.0 | 10 | 70 | 2,510 | 3 | 85 |
| 25 | 220 | H/7360-20 | T523H227M025APE070 | 43.0 | 550.0 | 20 | 70 | 2,510 | 3 | 85 |
| 35 | 22 | W/7343-15 | T523W226M035APE100 | 8.5 | 77.0 | 10 | 100 | 1,988 | 4 | 105 |
| 35 | 33 | V/7343-20 | T523V336M035APE100 | 12.8 | 115.5 | 10 | 100 | 2,030 | 4 | 105 |
| 35 | 47 | W/7343-15 | T523W476M035APE090 | 18.2 | 164.5 | 10 | 90 | 2,100 | 3 | 105 |
| 35 | 47 | W/7343-15 | T523W476M035APE100 | 18.2 | 164.5 | 10 | 100 | 1,988 | 3 | 105 |
| 35 | 47 | V/7343-20 | T523V476M035APE100 | 18.2 | 164.5 | 10 | 100 | 2,030 | 4 | 105 |
| 35 | 68 | V/7343-20 | T523V686M035APE070 | 26.4 | 238.0 | 10 | 70 | 2,420 | 3 | 105 |
| 35 | 68 | V/7343-20 | T523V686M035APE100 | 26.4 | 238.0 | 10 | 100 | 2,030 | 3 | 105 |
| 35 | 100 | H/7360-20 | T523H107M035APE070 | 38.8 | 350.0 | 10 | 70 | 2,510 | 3 | 85 |
| VDC | µF | KEMET/ EIA | | mJ | µA | % | mΩ | mA | | °C |
| Rated Voltage | Rated Capacitance | Case Code/ Case Size | KEMET Part Number | Energy | Maximum DC Leakage | Maximum DF | Maximum ESR | Maximum Allowable RMS Ripple Current | MSL | Maximum Operating Temperature |

***Part numbers marked in orange font are not recommended for new designs. KEMET recommends the use of part numbers shown in the above table within same Cap/Volt/Case and ESR in black font text.***

*(1) To complete KEMET part number, insert M for ±20% or K for ±10%. Designates capacitance tolerance.*
*Refer to Ordering Information for additional detail.*
*Energy (mJ) = 0.5 * Nominal Cap * (Application Voltage^2 - Dropout Voltage^2) / 1,000; Cap = µF*
*Application Voltage = 90% of $V_R$ (≤ 10 V) / 80% of $V_R$ (> 10 V)*
*Dropout Voltage = 3 V was used for the calculation*

## Derating Guidelines




| Voltage Rating | Maximum Recommended Steady State Voltage | |
|---|---|---|
| | −55°C to 105°C | −55°C to 125°C |
| 6.3 V ≤ $V_R$ ≤ 10 V | 90% of $V_R$ | 60% of $V_R$ |
| 10 V < $V_R$ | 80% of $V_R$ | 53% of $V_R$ |

*$V_R$ = Rated Voltage*

### Recommended Application Voltage

KO-CAPs are solid state capacitors that demonstrate no wearout mechanism when operated within their recommended guidelines. While the KO-CAP can be operated at full rated voltage, most circuit designers seek a minimum level of assurance in long term reliability, which should be demonstrated with data. A voltage derating can provide the desired level of demonstrated reliability based on industry accepted acceleration models. Since most applications do require long term reliability, KEMET recommends that designers consider a 10% voltage derating, according to the graphic above, for the maximum steady state voltage.

## Ripple Current/Ripple Voltage

Permissible AC ripple voltage and current are related to equivalent series resistance (ESR) and the power dissipation capabilities of the device.

Permissible AC ripple voltage which may be applied is limited by two criteria:
a. The positive peak AC voltage plus the DC bias voltage, if any, must not exceed the DC voltage rating of the capacitor.
b. The negative peak AC voltage, in combination with bias voltage, if any, must not exceed the allowable limits specified for reverse voltage.

The maximum power dissipation by case size can be determined using the below table.

| Temperature Compensation Multipliers for Maximum Ripple Current | | |
|---|---|---|
| T ≤ 45°C | 45° C < T ≤ 85°C | 85°C < T ≤ 125°C |
| 1.00 | 0.70 | 0.25 |

*T = Environmental temperature*

Using the P max of the device, the maximum allowable rms ripple current or voltage may be determined.

$I(max) = \sqrt{P\ max/R}$
$E(max) = Z \sqrt{P\ max/R}$

*I = rms ripple current (amperes)*
*E = rms ripple voltage (volts)*
*P max = maximum power dissipation(watts)*
*R = ESR at specified frequency (ohms)*
*Z = Impedance at specified frequency (Ohms)*

*Refer to part number listings for permittable Arms limits.*

| Case Code | EIA Case Code | Maximum Power Dissipation (P max) mWatts at 45°C with +30°C Rise | |
|---|---|---|---|
| | | For T520/T521/T545 | For T523/T548 |
| T | 3528-12 | 105 | N/A |
| M | 3528-15 | 120 | N/A |
| B | 3528-21 | 127 | N/A |
| W | 7343-15 | 180 | 395 |
| V | 7343-20 | 187 | 410 |
| Y | 7343-40 | 241 | N/A |
| X | 7343-43 | 247 | N/A |
| G | 7330-12 | N/A | 300 |
| J | 7360-15 | 200 | 440 |
| H | 7360-20 | 200 | 440 |
| O | 7360-43 | 300 | N/A |

*The maximum power dissipation rating must be reduced with increasing environmental operating temperatures. Refer to the Temperature Compensation Multiplier table for details.*

## Surge Voltage

Surge voltage is the maximum voltage (peak value) which may be applied to the capacitor. The surge voltage must not be applied for periodic charging and discharging in the course of normal operation and cannot be part of the application voltage. Surge voltage capability is demonstrated by application of 1,000 cycles at operating temperature. The parts are charged through a 33 Ohm resistor for 30 seconds and then discharged though a 33 Ohm resistor for each cycle.

| Rated Voltage (V) | Surge Voltage (V) | Category Voltage (V) | Category Surge Voltage (V) |
|---|---|---|---|
| −55°C to 105°C | | Up to 125°C | |
| 2.5 | 3.3 | – | – |
| 6.3 | 8.3 | – | – |
| 10 | 13.2 | – | – |
| 16 | 21.1 | – | – |
| 20 | 26.4 | 13.4 | 17.4 |
| 25 | 33.0 | – | – |
| 35 | 46.2 | – | – |

## Reverse Voltage

Polymer electrolytic capacitors are polar devices and may be permanently damaged or destroyed if connected in the wrong polarity. These devices will withstand a small degree of transient voltage reversal for short periods as shown in the below table.

| Temperature | Permissible Transient Reverse Voltage |
|---|---|
| 25°C | 15% of Rated Voltage |
| 55°C | 10% of Rated Voltage |
| 85°C | 5% of Rated Voltage |
| 105°C | 3% of Rated Voltage |
| 125°C* | 1% of Rated Voltage |

**For series rated to 125°C*

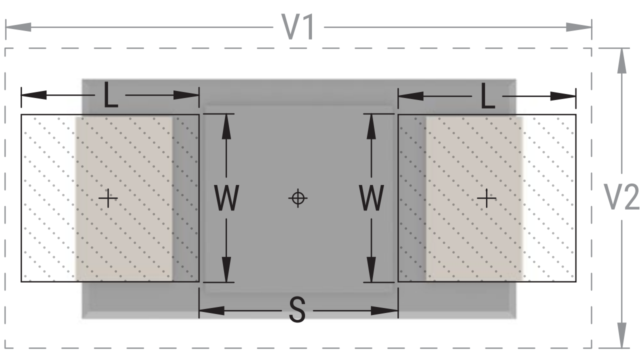
## Table 2 – Land Dimensions/Courtyard

For T520/T521/T545

| KEMET | Metric Size Code | Density Level A: Maximum (Most) Land Protrusion (mm) | | | | | Density Level B: Median (Nominal) Land Protrusion (mm) | | | | | Density Level C: Minimum (Least) Land Protrusion (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case | EIA | W | L | S | V1 | V2 | W | L | S | V1 | V2 | W | L | S | V1 | V2 |
| T | 3528–12 | 2.35 | 2.21 | 0.92 | 6.32 | 4.00 | 2.23 | 1.80 | 1.12 | 5.22 | 3.50 | 2.13 | 1.42 | 1.28 | 4.36 | 3.24 |
| B | 3528–21 | 2.35 | 2.21 | 0.92 | 6.32 | 4.00 | 2.23 | 1.80 | 1.12 | 5.22 | 3.50 | 2.13 | 1.42 | 1.28 | 4.36 | 3.24 |
| M | 3528-15 | 2.35 | 2.21 | 0.92 | 6.32 | 4.00 | 2.23 | 1.80 | 1.12 | 5.22 | 3.50 | 2.13 | 1.42 | 1.28 | 4.36 | 3.24 |
| W | 7343–15 | 2.55 | 2.77 | 3.67 | 10.22 | 5.60 | 2.43 | 2.37 | 3.87 | 9.12 | 5.10 | 2.33 | 1.99 | 4.03 | 8.26 | 4.84 |
| V | 7343–20 | 2.55 | 2.77 | 3.67 | 10.22 | 5.60 | 2.43 | 2.37 | 3.87 | 9.12 | 5.10 | 2.33 | 1.99 | 4.03 | 8.26 | 4.84 |
| Y[1] | 7343–40 | 2.55 | 2.77 | 3.67 | 10.22 | 5.60 | 2.43 | 2.37 | 3.87 | 9.12 | 5.10 | 2.33 | 1.99 | 4.03 | 8.26 | 4.84 |
| X[1] | 7343–43 | 2.55 | 2.77 | 3.67 | 10.22 | 5.60 | 2.43 | 2.37 | 3.87 | 9.12 | 5.10 | 2.33 | 1.99 | 4.03 | 8.26 | 4.84 |
| J | 7360-15 | 4.25 | 2.77 | 3.67 | 10.22 | 7.30 | 4.13 | 2.37 | 3.87 | 9.12 | 6.80 | 4.03 | 1.99 | 4.03 | 8.26 | 6.54 |
| H | 7360-20 | 4.25 | 2.77 | 3.67 | 10.22 | 7.30 | 4.13 | 2.37 | 3.87 | 9.12 | 6.80 | 4.03 | 1.99 | 4.03 | 8.26 | 6.54 |
| O[1] | 7360-43 | 4.25 | 2.77 | 3.67 | 10.22 | 7.30 | 4.13 | 2.37 | 3.87 | 9.12 | 6.80 | 4.03 | 1.99 | 4.03 | 8.26 | 6.54 |

***Density Level A:*** *For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.*
***Density Level B:*** *For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.*
***Density Level C:*** *For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC standard 7351 (IPC–7351).*

[1] *Height of these chips may create problems in wave soldering.*



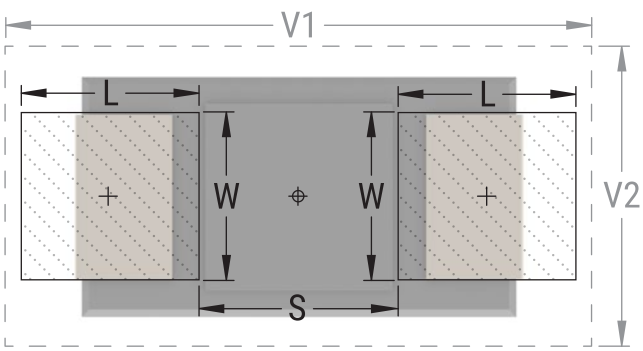
Grid Placement Courtyard

## Table 2 – Land Dimensions/Courtyard cont.

For T523/T548

| KEMET | Metric Size Code | Density Level A: Maximum (Most) Land Protrusion (mm) | | | | | Density Level B: Median (Nominal) Land Protrusion (mm) | | | | | Density Level C: Minimum (Least) Land Protrusion (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case | EIA | W | L | S | V1 | V2 | W | L | S | V1 | V2 | W | L | S | V1 | V2 |
| W | 7343-15 | 2.55 | 2.77 | 3.67 | 10.22 | 5.60 | 2.43 | 2.37 | 3.87 | 9.12 | 5.10 | 2.33 | 1.99 | 4.03 | 8.26 | 4.84 |
| V | 7343-20 | 2.55 | 2.77 | 3.67 | 10.22 | 5.60 | 2.43 | 2.37 | 3.87 | 9.12 | 5.10 | 2.33 | 1.99 | 4.03 | 8.26 | 4.84 |
| G | 7360-12 | 4.60 | 3.07 | 3.07 | 10.22 | 7.30 | 4.48 | 2.67 | 3.27 | 9.12 | 6.80 | 4.38 | 2.29 | 3.43 | 8.26 | 6.54 |
| J | 7360-15 | 4.60 | 3.07 | 3.07 | 10.22 | 7.30 | 4.48 | 2.67 | 3.27 | 9.12 | 6.80 | 4.38 | 2.29 | 3.43 | 8.26 | 6.54 |
| H | 7360-20 | 4.60 | 3.07 | 3.07 | 10.22 | 7.30 | 4.48 | 2.67 | 3.27 | 9.12 | 6.80 | 4.38 | 2.29 | 3.43 | 8.26 | 6.54 |

***Density Level A:*** *For low-density product applications. Recommended for wave solder applications and provides a wider process window for reflow solder processes.*
***Density Level B:*** *For products with a moderate level of component density. Provides a robust solder attachment condition for reflow solder processes.*
***Density Level C:*** *For high component density product applications. Before adapting the minimum land pattern variations the user should perform qualification testing based on the conditions outlined in IPC standard 7351 (IPC–7351).*



Grid Placement Courtyard

## Soldering Process

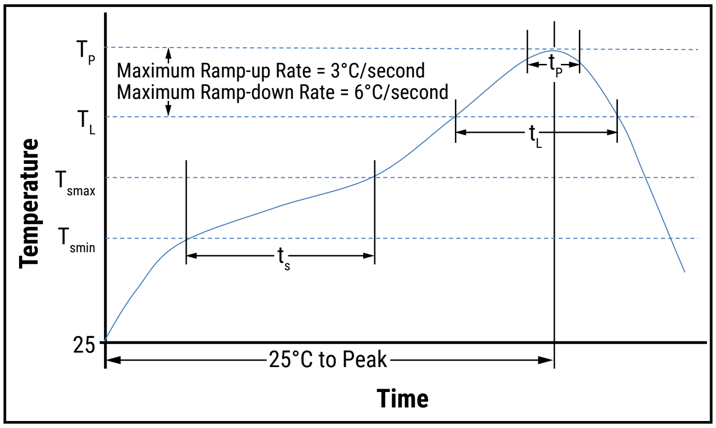
The KEMET families of surface mount capacitors are compatible with wave (single or dual), convection, IR, or vapor phase reflow techniques. Preheating of these components is recommended to avoid extreme thermal stress. KEMET's recommended profile conditions for convection and IR reflow reflect the profile conditions of the IPC/J–STD–020D standard for moisture sensitivity testing. The devices can safely withstand a maximum of three reflow passes at these conditions.

Please note that although the X/7343–43 and O/7360-43 case size can withstand wave soldering, the tall profile (4.3 mm maximum) dictates care in wave process development.

Hand soldering should be performed with care due to the difficulty in process control. If performed, care should be taken to avoid contact of the soldering iron to the molded case. The iron should be used to heat the solder pad, applying solder between the pad and the termination, until reflow occurs. Once reflow occurs, the iron should be removed immediately. "Wiping" the edges of a chip and heating the top surface is not recommended.

| Profile Feature | Pb-Free Assembly |
|---|---|
| Preheat/Soak | |
| Temperature Minimum ($T_{Smin}$) | 150°C |
| Temperature Maximum ($T_{Smax}$) | 200°C |
| Time ($t_s$) from $T_{smin}$ to $T_{smax}$) | 60 – 120 seconds |
| Ramp-up Rate ($T_L$ to $T_P$) | 3°C/second maximum |
| Liquidous Temperature ($T_L$) | 217°C |
| Time Above Liquidous ($t_L$) | 60 – 150 seconds |
| Peak Temperature ($T_P$) | 250°C*<br>260°C** |
| Time within 5°C of Maximum Peak Temperature ($t_P$) | 30 seconds maximum |
| Ramp-down Rate ($T_P$ to $T_L$) | 6°C/second maximum |
| Time 25°C to Peak Temperature | 8 minutes maximum |

*Note: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow.*
** For Case Size height > 2.5 mm*
*** For Case Size height ≤ 2.5 mm*




## Storage

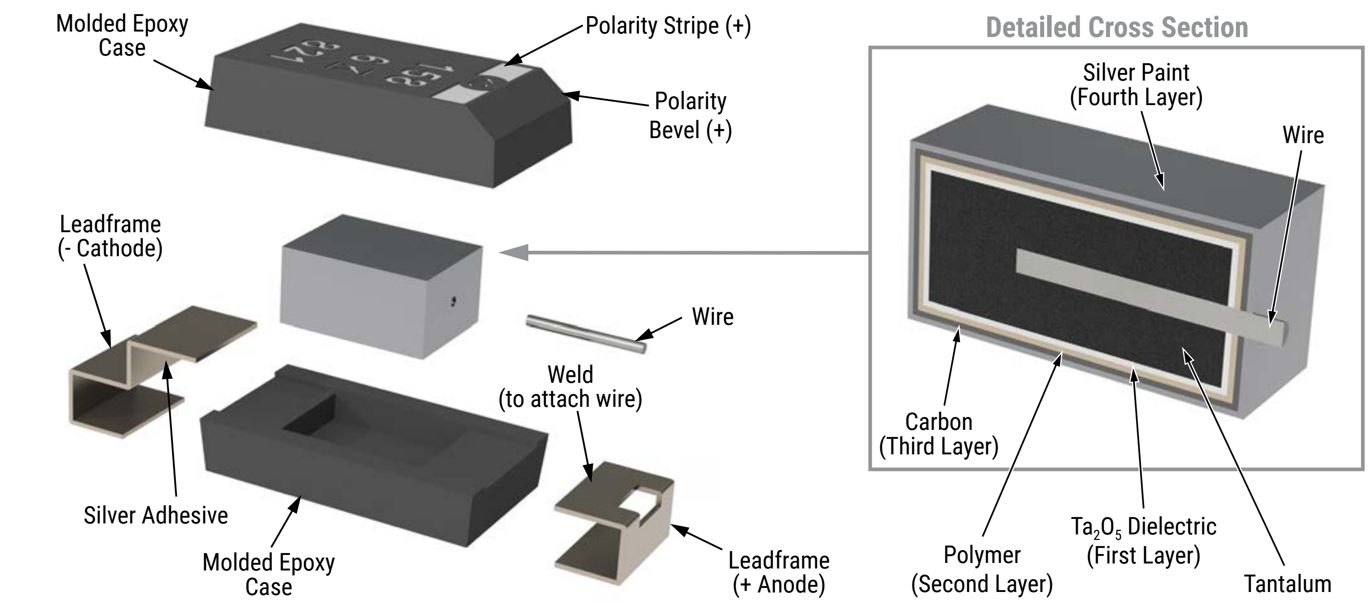
All KO-Cap are shipped in moisture barrier bags (MBBs) with desiccant and humidity indicator card (HIC). These parts are classified as moisture sensitivity level 3 (MSL3) or moisture sensitivity level 4 (MSL4) per IPC/JEDEC J-STD-020 and packaged per IPC/JEDEC J–STD–033. Refer to Table 1 for part type specification. MSL3 specifies a floor time of 168H at 30°C maximum temperature and 60% relative humidity. MSL4 specifies a floor time of 72H at 30°C maximum temperature and 60% relative humidity. Unused capacitors should be sealed in a MBB with fresh desiccant.

Calculated shelf life in sealed bag:
– 12 months from bag seal date in a storage environment of < 40°C and humidity < 90% RH
– 24 months from bag seal date in a storage environment of < 30°C and humidity < 70% RH

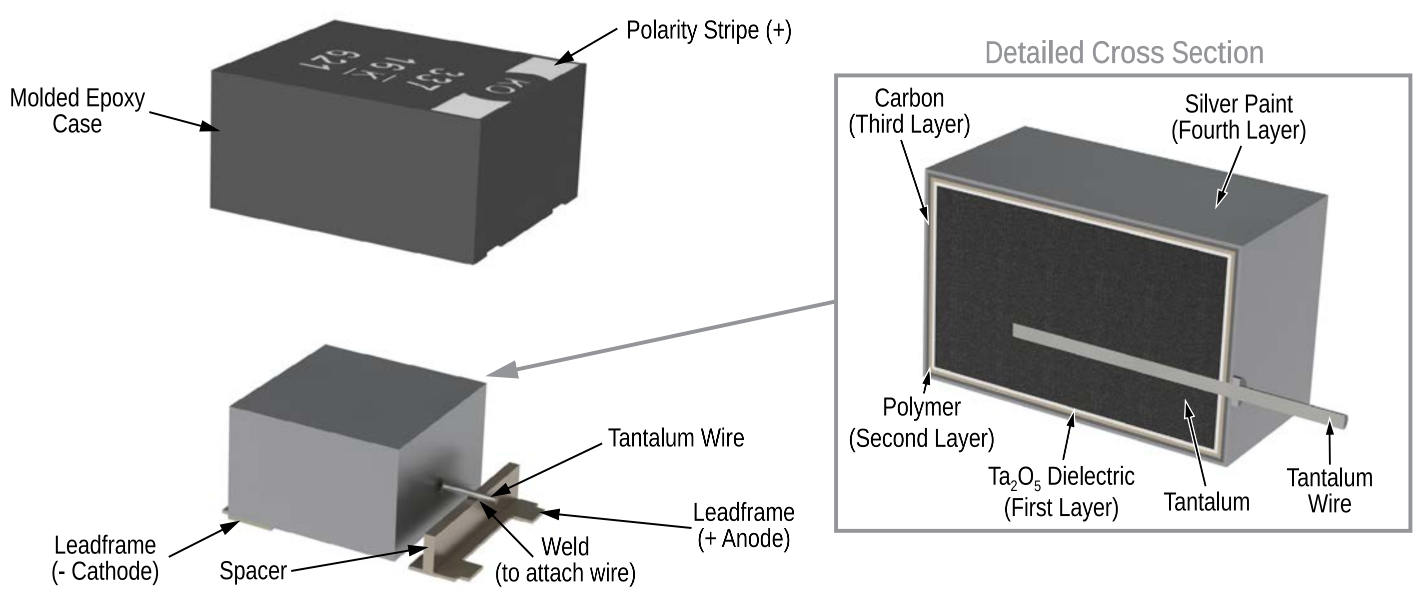
If baking is required, refer to IPC/JEDEC J–STD–033 for bake procedure

# Construction

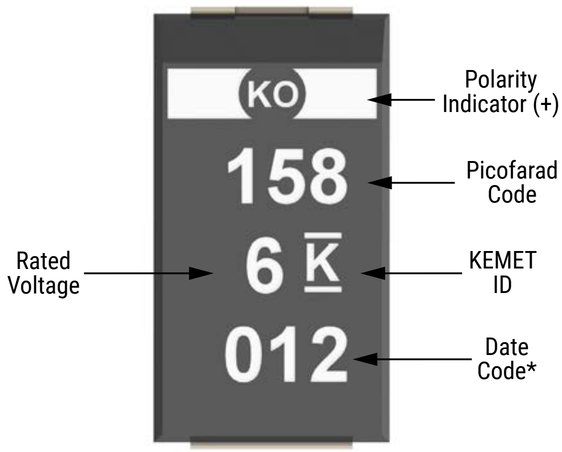
## T520/T521/T545




## T523/T548



## Capacitor Marking

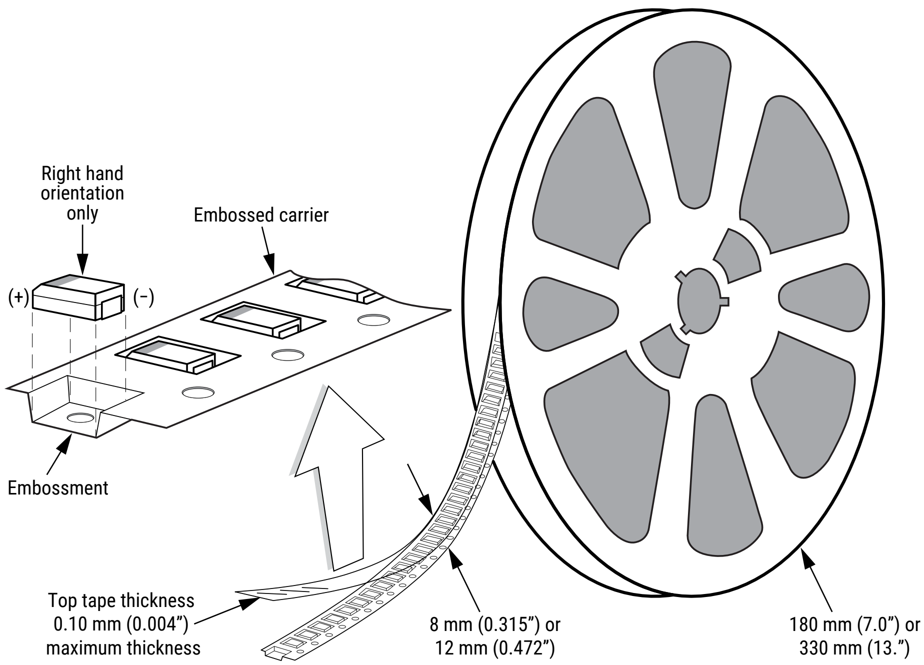



* 012 = 12TH week of 2020

| Date Code * | |
|---|---|
| 1st digit = Last number of year | 6 = 2016<br>7 = 2017<br>8 = 2018<br>9 = 2019<br>0 = 2020 |
| 2nd and 3rd digit = Week of the year | 01 = 1st week of the year to<br>52 = 52nd week of the year |

## Tape & Reel Packaging Information

KEMET's molded chip capacitor families are packaged in 8 and 12 mm plastic tape on 7" and 13" reels in accordance with *EIA Standard 481:* Embossed Carrier Taping of Surface Mount Components for Automatic Handling. This packaging system is compatible with all tape-fed automatic pick-and-place systems.

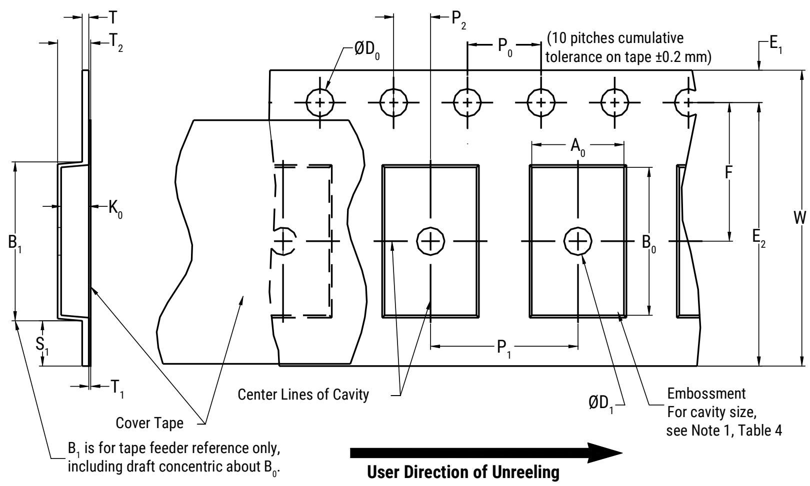



## Table 3 – Packaging Quantity

| Case Code | | Tape Width (mm) | 7" Reel* | 13" Reel* |
|---|---|---|---|---|
| KEMET | EIA | | | |
| T | 3528-12 | 8 | 2,500 | 10,000 |
| M | 3528-15 | 8 | 2,000 | 8,000 |
| B | 3528-21 | 8 | 2,000 | 8,000 |
| W | 7343-15 | 12 | 1,000 | 3,000 |
| V | 7343-20 | 12 | 1,000 | 3,000 |
| Y | 7343-40 | 12 | 500 | 2,000 |
| X | 7343-43 | 12 | 500 | 2,000 |
| J | 7360-15 | 12 | 1,000 | 3,000 |
| H | 7360-20 | 12 | 1,000 | 3,000 |
| O | 7360-43 | 12 | 500 | 2,000 |

** No C-Spec required for 7" reel packaging. C-7280 required for 13" reel packaging.*

## Figure 1 – Embossed (Plastic) Carrier Tape Dimensions




## Table 4 – Embossed (Plastic) Carrier Tape Dimensions

Metric will govern

| Constant Dimensions — Millimeters (Inches) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tape Size | $D_0$ | $D_1$ Minimum Note 1 | $E_1$ | $P_0$ | $P_2$ | R Reference Note 2 | $S_1$ Minimum Note 3 | T Maximum | $T_1$ Maximum |
| 8 mm | 1.5 +0.10/−0.0 (0.059 +0.004/−0.0) | 1.0 (0.039) | 1.75 ±0.10 (0.069 ±0.004) | 4.0 ±0.10 (0.157 ±0.004) | 2.0 ±0.05 (0.079 ±0.002) | 25.0 (0.984) | 0.600 (0.024) | 0.600 (0.024) | 0.100 (0.004) |
| 12 mm | | 1.5 (0.059) | | | | 30 (1.181) | | | |

| Variable Dimensions — Millimeters (Inches) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Tape Size | Pitch | $B_1$ Maximum Note 4 | $E_2$ Minimum | F | $P_1$ | $T_2$ Maximum | W Maximum | $A_0$, $B_0$ & $K_0$ |
| 8 mm | Single (4 mm) | 4.35 (0.171) | 6.25 (0.246) | 3.5 ±0.05 (0.138 ±0.002) | 2.0 ±0.05 or 4.0 ±0.10 (0.079 ±0.002 or 0.157 ±0.004) | 2.5 (0.098) | 8.3 (0.327) | Note 5 |
| 12 mm | Single (4 mm) and Double (8 mm) | 8.2 (0.323) | 10.25 (0.404) | 5.5 ±0.05 (0.217 ±0.002) | 2.0 ±0.05 (0.079 ±0.002) or 4.0 ±0.10 (0.157 ±0.004) or 8.0 ±0.10 (0.315 ±0.004) | 4.6 (0.181) | 12.3 (0.484) | |

*1. The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.*

*2. The tape, with or without components, shall pass around R without damage (see Figure 4).*

*3. If $S_1$ < 1.0 mm, there may not be enough area for cover tape to be properly applied (see EIA Standard 481–D, paragraph 4.3, section b).*

*4. $B_1$ dimension is a reference dimension for tape feeder clearance only.*

*5. The cavity defined by $A_0$, $B_0$ and $K_0$ shall surround the component with sufficient clearance that:*

*(a) the component does not protrude above the top surface of the carrier tape.*

*(b) the component can be removed from the cavity in a vertical direction without mechanical restriction, after the top cover tape has been removed.*

*(c) rotation of the component is limited to 20° maximum for 8 and 12 mm tapes (see Figure 2).*

*(d) lateral movement of the component is restricted to 0.5 mm maximum for 8 mm and 12 mm wide tape (see Figure 3).*

*(e) see Addendum in EIA Standard 481–D for standards relating to more precise taping requirements.*

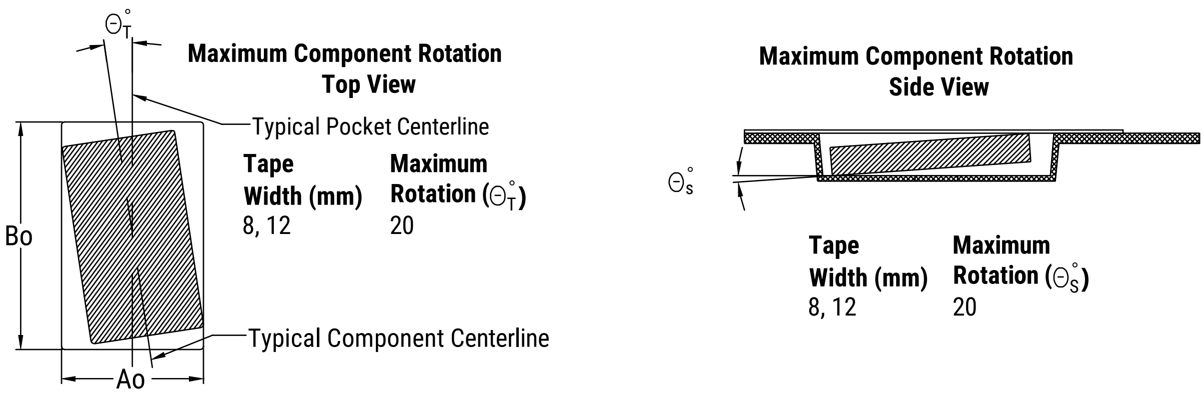
## Packaging Information Performance Notes

**1. Cover Tape Break Force:** 1.0 kg minimum.
**2. Cover Tape Peel Strength:** The total peel strength of the cover tape from the carrier tape shall be:

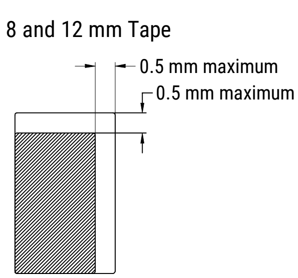
| Tape Width | Peel Strength |
|---|---|
| 8 mm | 0.1 to 1.0 Newton (10 to 100 gf) |
| 12 and 16 mm | 0.1 to 1.3 Newton (10 to 130 gf) |

The direction of the pull shall be opposite the direction of the carrier tape travel. The pull angle of the carrier tape shall be 165° to 180° from the plane of the carrier tape. During peeling, the carrier and/or cover tape shall be pulled at a velocity of 300 ±10 mm/minute.
**3. Labeling:** Bar code labeling (standard or custom) shall be on the side of the reel opposite the sprocket holes. *Refer to EIA Standards 556 and 624.*

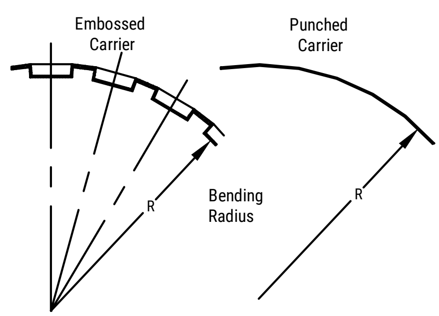
## Figure 2 – Maximum Component Rotation



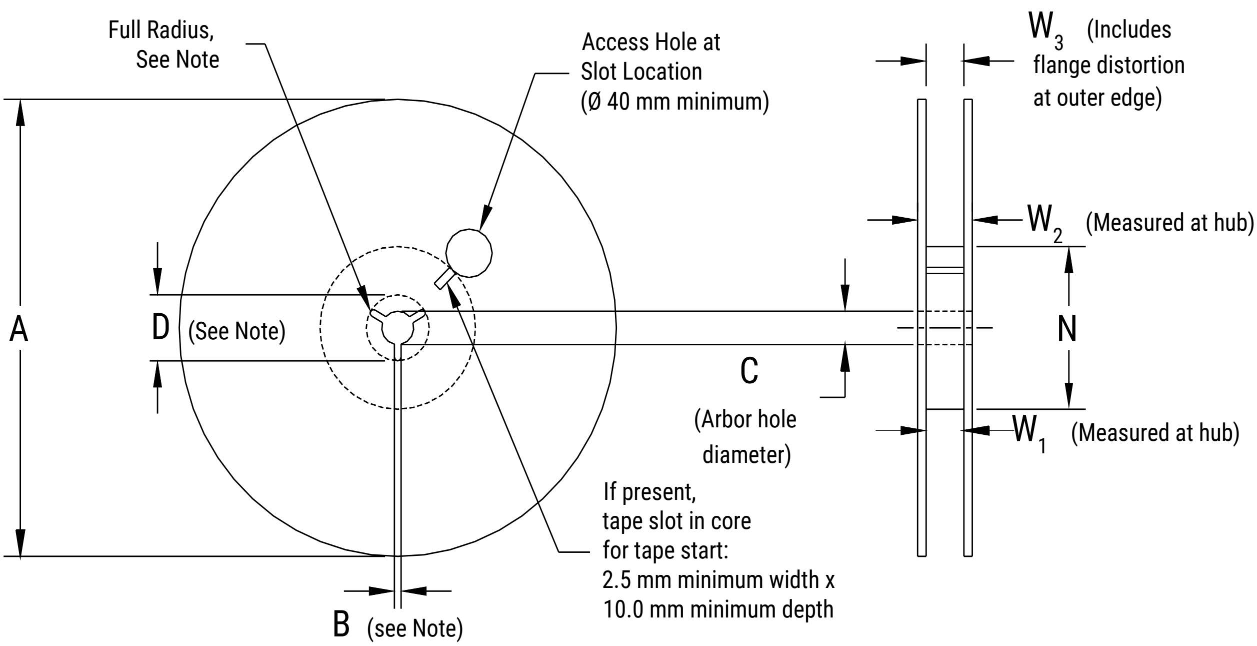

## Figure 3 – Maximum Lateral Movement




## Figure 4 – Bending Radius



## Figure 5 – Reel Dimensions



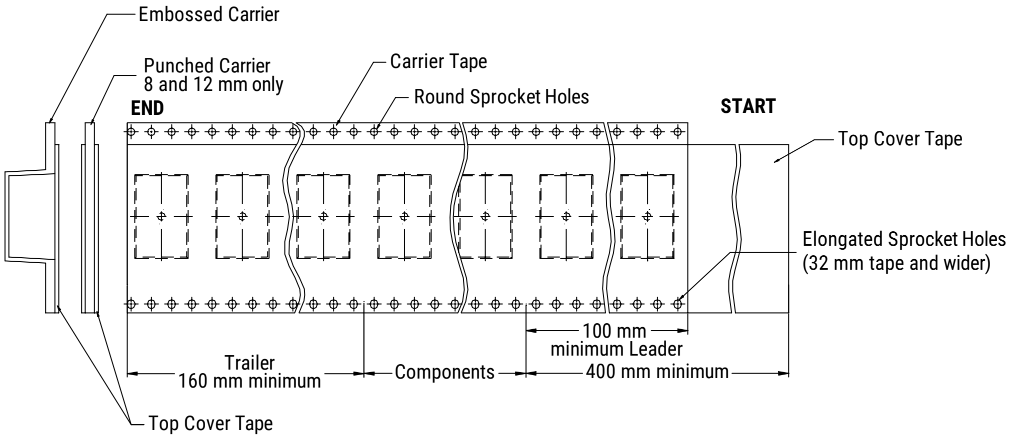

Note: Drive spokes optional; if used, dimensions B and D shall apply.

## Table 5 – Reel Dimensions

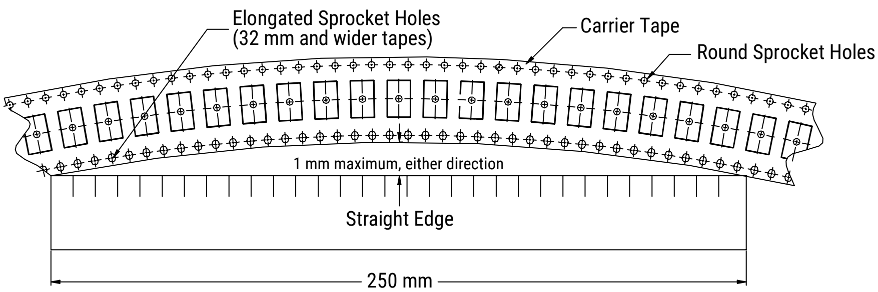
Metric will govern

| Constant Dimensions — Millimeters (Inches) | | | | |
|---|---|---|---|---|
| Tape Size | A | B Minimum | C | D Minimum |
| 8 mm | 178 ±0.20<br>(7.008 ±0.008)<br>or<br>330 ±0.20<br>(13.000 ±0.008) | 1.5<br>(0.059) | 13.0 +0.5/−0.2<br>(0.521 +0.02/−0.008) | 20.2<br>(0.795) |
| 12 mm | | | | |
| **Variable Dimensions — Millimeters (Inches)** | | | | |
| Tape Size | N Minimum | $W_1$ | $W_2$ Maximum | $W_3$ |
| 8 mm | 50<br>(1.969) | 8.4 +1.5/−0.0<br>(0.331 +0.059/−0.0) | 14.4<br>(0.567) | Shall accommodate tape width without interference |
| 12 mm | | 12.4 +2.0/−0.0<br>(0.488 +0.078/−0.0) | 18.4<br>(0.724) | |

## Figure 6 – Tape Leader & Trailer Dimensions




## Figure 7 – Maximum Camber



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